REMARKS

Reconsideration of the above-identified application in view of the amendments above and the remarks following is respectfully requested.

Claims 1-10, 12-18, 20-26 and 28-39 have been rejected under 35 U.S.C. § 102(b) as being clearly anticipated by Akiyama et al. US 5,883,720. Claims 11, 19, 27 and 40 have been rejected under 35 U.S.C. § 103(a) as being rendered obvious over Akiyama.

In the present amendment, claim 1 has been rewritten to include the limitation of original claims 8 and 11 and the additional limitation that the comparison is not carried out between the spectra but rather between information of individual layers given by the spectra as processed in the manner described. The limitation of claim 11 has been modified based on the disclosure on page 17 line 17 to recite "orthogonal transformation" which is more general than "Fourier transformation". The remaining independent claims have been rewritten with corresponding limitations.

The Examiner rejected claims 11, 19, 27 and 40, which specifically refer to Fourier processing, as being rendered obvious by Akiyama since Akiyama discusses comparisons of spectra in the circumstances of production line processing and Fourier is simply a well known method of analyzing spectral information.

In response, orthogonal processing, a generalization of Fourier processing supported on page 17 line 17 of the present application, has been incorporated into the main claims together with an additional feature, that the use of the orthogonal processing allows for comparison of information relating to individual layers in the products being manufactured, and more specifically that the comparison is carried out using the results of the orthogonal processing, that is using the layer thickness information.

In Akiyama, the products or part products are tested during processing by comparing spectra. Akiyama relates to multilayer coating of a recording CD and specifically to analyzing a top layer after deposition taking into consideration the lower layers. Akiyama specifies a method of calculation of the change in thickness of the lower layers of a recording CD by monitoring for a difference between maxima and minima of the reflectance spectrum and *then* calculating the change of thickness of the lower and upper. Following calculations of the thickness change at the upper and lower layers a calculation is made of the deposition rate and other actions.

Akiyama uses the obtained spectra directly and does not insert a phase of orthogonal analysis prior to the comparison. Neither does Akiyama provide any hint of inserting such a phase. Consequently, Akiyama is merely able to determine that the two spectra are different and consequently that the layer deposition has not been carried out according to plan. Akiyama is not able to determine where the problem lies in terms of individual layers and consequently is not able to determine suitable rerouting for troublesome batches. In fact, as shown in the theory part of the present application, the maxima and minima to which Akiyama refers, do not directly indicate the lower and upper layers contrary to Akiyama's teaching. Akiyama remains oblivious even to the existence of such a deficiency, and certainly does not propose a solution thereto. The present application adds inventive matter both by recognizing the problem and by providing a practical solution thereto, namely adding a stage of orthogonal transformation prior to carrying out the comparison.

More specifically, every production line screening system requires a measurable value and a criterion based on the measurable value to decide about pass and fail. Just finding out that a reflection spectrum is different from a reference spectrum is not sufficient to allow such control to work. As discussed in the introduction to the present application, and from the theory part of the description of the present invention itself, measuring carried out on production wafers with multiple layers and complicated patterns result in a complicated reflection intensity spectrum. Changes in the spectrum can come from different sources, either from the lower layers or from the upper layers. A small change in each of several layers can easily lead to the same shift in the reflected spectrum as a large change in a single layer, making it difficult to determine whether any given process stage is responsible for an unexpected shift. Generally it is changes in the upper layers that are germane to any current routing or like decision. Because Akiyama fails to apply orthogonal processing prior to his comparison, he is unable to distinguish between changes in the lower layers and those of the upper layer to the level of accuracy necessary for semiconductors line screening. In other words he does not have layer-specific information.

The only way to do the screening is by separating the influence of each of the layers and structures by carrying out an orthogonal, typically Fourier, Hadamard end etc. transform and thereby relating the individual frequencies to individual layers and thicknesses thereof. Such layer specific data can then be used in an informed comparison to make a fail-pass test for the component.

Thus, in contrast to Akiyama, the system of the present invention applies orthogonal analysis to the spectra that are obtained, and the analysis is carried out prior to the comparison stage. The orthogonal analysis provides for explicit information regarding the thicknesses of the surface layers and those beneath, and when the results of the orthogonal analysis are compared, what is actually being compared arethe layer thicknesses. Thus the present invention allows for real time determination of layer thickness data, which can then be compared with expected thicknesses, and rerouting of the products can then be carried out based on precise information.

Whilst the point made by the Examiner - that Fourier analysis is well-known in the art in the field of spectral processing - is agreed with, it is not believed that it was obvious that orthogonal analysis, including Fourier analysis, applied to such spectra, would reveal detailed layer thickness information for a subsequent comparison. Indeed it is not believed that the prior art expresses any awareness that direct use of the spectrum fails to give accurate layer information. It is certainly clear that the prior art provides no suggestion that the layer-specific information, which is lacking can be obtained by adding a stage of orthogonal transformation after obtaining the reflection spectrum and prior to carrying out the comparison.

Even if it were obvious that Fourier analysis would provide such thickness information it was not obvious that it would provide such information in real time to allow for direct screening of a production line process. Indeed it is believed that Akiyama deliberately limits his spectral processing to a simple direct comparison in order to provide himself with real time results.

More particularly there is no hint given in Akiyama that processing should be modified to provide accurate layer thickness information. He gives no hint either that such data is lacking or that he needs such accurate data.

There is no hint in Akiyama as to how the processing could be modified to provide layer thickness information and there is no hint as to the advisability of using Fourier, or like orthogonal, transformations for that or any other reason. It is thus not possible for the person skilled in the art to study Akiyama, apply merely his general knowledge of the field and arrive at the present invention.

It is thus respectfully submitted that, in light of the above the amended claims are novel and non-obvious, and overcome all of the points raised by the Examiner. The dependent claims are believed to be allowable as being based on allowable main claims. No new matter has been added by virtue of the above amendments.

Attached herewith is a marked up version of the changes made to the claims by the current amendment. The attached pages are captioned "**<u>Version marked to show changes made</u>**".

In view of the above amendments and remarks it is respectfully submitted that all the pending claims are all now in condition for allowance. Prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Claims 1, 2, 5, 6, 9 - 14, 17 - 20, 22, 25 - 31, 34, 35 and 38 - 40 have been amended.

Claims 8, 16, 24, and 37 have been deleted.

Claim 1 has been amended as follows:

--1 (Amended). A production line having a plurality of successive stages for construction of a product comprising at least one layer on a substrate, and routers for transferring partly constructed products between the stages such that each stage receives a respective predefined partly constructed product as its input, the production line comprising:

a predetermined reflected light intensity spectrum for at least one stage representing the respective predefined part construction for the stage,

a reflected light intensity spectrum deriver located at said at least one stage operable to obtain reflected light intensity spectra of incoming partly constructed product, said intensity spectrum deriver comprising:

an illuminator for irradiating a part product at least one point thereof with a multiple wavelength radiation source,

an intensity detector for detecting intensities within reflections of said source from said point,

an analyzer operatively associated with said intensity detector for analyzing said intensities in terms of wavelength and converting said analyzed intensities spectrum into a frequency spectrum thereof, said analyzer comprising an orthogonal transform calculator for producing said frequency spectrum by orthogonal transformation of said analyzed intensity spectrum, thereby to reveal thickness information of individual layers, and

a layer property determiner for determining, from said orthogonal transformation of said frequency spectrum, layer properties of layers on said part product, and

a comparator, for comparing said obtained reflected light intensity spectra with said predetermined reflected light intensity spectrum, to determine whether layers of

said incoming partly constructed products correspond with layers defined in said respective predefined part construction for the stage. --

Claim 2 has been amended as follows:

--2 (Amended). A production line according to claim 1, further comprising a routing error indicator operatively associated with said comparator for indicating a routing error when said spectra layers do not match. --

Claim 5 has been amended as follows:

--5 (Amended). A production line according to claim 4, wherein each stage comprises a reflected light intensity spectrum deriver and a layer property determiner and has a predetermined intensity spectrum and predetermined layer properties. --

Claim 6 has been amended as follows:

--6 (Amended). A production line according to claim 5, wherein said comparator is further operable to compare said obtained reflected light intensity spectrumlayer properties with predetermined spectralayer properties of at least one other stage to reroute said product to said other stage if layers indicated in said spectra match. --

Delete Claim 8

Claim 9 has been amended as follows:

--9 (Amended). A production line according to claim 81, wherein said property is one of a group comprising a thickness and a refractive index. --

Claim 10 has been amended as follows:

--10 (Amended). A production line according to claim 81, wherein said part product includes at least one at least partly transparent layer and said reflections include reflections from an upper and a lower surface of said at least partly transparent layer. --

Claim 11 has been amended as follows:

--11 (Amended). A production line according to claim 81, wherein said analyzer orthogonal transform calculator comprises a Fourier transform calculator for producing said frequency spectrum by Fourier transformation of said analyzed intensity spectrum. --

Claim 12 has been amended as follows:

--12 (Amended). A tool guard for restricting input to a production tool for carrying out a stage in the production of a layered product, the tool guard comprising:

a predetermined intensity spectrum representing an expected part construction for the stage,

an intensity spectrum deriver located at said tool operable to obtain an intensity spectrum of an incoming partly constructed product, said intensity spectrum deriver comprising:

an illuminator for irradiating a part product at at least one point thereof with a multiple wavelength radiation source,

an intensity detector for detecting intensities within reflections of said source from said point,

an analyzer operatively associated with said intensity detector for analyzing said intensities in terms of wavelength and converting said analyzed intensities spectrum into a frequency spectrum thereof, said analyzer comprising an orthogonal transform calculator for producing said frequency spectrum by orthogonal transformation of said analyzed intensity spectrum, thereby to reveal thickness information of individual layers, and

a layer property determiner for determining, from said orthogonal transformation of said frequency spectrum, layer properties of layers on said part product, and

a comparator, for comparing said obtained intensity spectrum with said predetermined intensity spectrum, to determine whether layers properties of ysaid incoming partly constructed product corresponds with layers propertyies of said respective predefined part construction for the stage. --

Claim 13 has been amended as follows:

--13 (Amended). A tool guard according to claim 12, further comprising a routing error indicator operatively associated with said comparator for indicating a routing error when said spectra layers propertyies do not match. --

Claim 14 has been amended as follows:

--14 (Amended). A tool guard according to claim 13, comprising a production interruption mechanism operatively associated with said routing error indicator for interruption of operation of said tool in the event of indication of a routing error. --

Delete Claim 16

Claim 17 has been amended as follows:

--17 (Amended).A tool guard according to claim 1612, wherein said property is one of a group comprising a thickness and a refractive index. --

Claim 18 has been amended as follows:

--18 (Amended).A tool guard according to claim 1612, wherein said part product includes at least one at least partly transparent layer and said reflections include reflections from an upper and a lower surface of said at least partly transparent layer. --

Claim 19 has been amended as follows:

--19 (Amended).A tool guard according to claim 1612, wherein said analyzer orthogonal transform calculator comprises a Fourier transform calculator for producing said frequency spectrum by Fourier transform of said analyzed intensities. --

Claim 20 has been amended as follows:

--20 (Amended). A production line router for routing intermediate inputs around a multiple stage production line, the intermediate inputs comprising substrates with at least one superimposed layer, the router comprising:

predetermined intensity spectra for each of a plurality of said stages representing a respective intermediate construction for the stage,

at least one intensity spectrum deriver located within said production line for obtaining intensity spectra of intermediate inputs, said intensity spectrum deriver comprising:

an illuminator for irradiating a part product at at least one point thereof with a multiple wavelength radiation source,

an intensity detector for detecting intensities within reflections of said source from said point,

an analyzer operatively associated with said intensity detector for analyzing said intensities in terms of wavelength and converting said analyzed intensities spectrum into a frequency spectrum thereof, said analyzer comprising an orthogonal transform calculator for producing said frequency spectrum by orthogonal transformation of said analyzed intensity spectrum, thereby to reveal thickness information of individual layers, and

a layer property determiner for determining, from said orthogonal transformation of said frequency spectrum, layer properties of layers on said part product, and

a comparator, for obtaining a closest match between layers defined in said obtained intensity spectrum and layers defined in any of said predetermined spectra, said router being operable to route said intermediate input to a stage corresponding to said closest matching spectrum. --

Claim 22 has been amended as follows:

--22 (Amended). A production line router according to claim 21, wherein each stage comprises an intensity spectrum deriver and a layer property determiner and has a predetermined intensity spectrum and predetermined layer properties. --

Delete Claim 24

Claim 25 has been amended as follows:

--25 (Amended). A production line router according to claim 2420, wherein said property is one of a group comprising a thickness and a refractive index. --

Claim 26 has been amended as follows:

--26 (Amended). A production line router according to claim 2420, wherein said intermediate input includes at least one at least partly transparent layer and said reflections include reflections from an upper and a lower surface of said at least partly transparent layer. --

Claim 27 has been amended as follows:

--27 (Amended). A production line according to claim 2420, wherein said ~~analyzer~~ orthogonal transform ~~calcluator~~calculator comprises a Fourier transform calculator for producing said spectrum by Fourier transform of said analyzed intensities. --

Claim 28 has been amended as follows:

--28 (Amended). A wafer production history determiner for determining the production history of a semiconductor wafer product, the determiner comprising:

a plurality of predetermined intensity spectra for semiconductor wafer products having completed respective stages of a multiple stage semiconductor wafer production process,

an intensity spectrum deriver for obtaining an intensity spectrum of an incoming semiconductor wafer product said intensity spectrum deriver comprising:

an illuminator for irradiating a part product at at least one point thereof with a multiple wavelength radiation source,

an intensity detector for detecting intensities within reflections of said source from said point,

an analyzer operatively associated with said intensity detector for analyzing said intensities in terms of wavelength and converting said analyzed intensities spectrum into a frequency spectrum thereof, said analyzer comprising an orthogonal transform calculator for producing said frequency spectrum by orthogonal transformation of said analyzed intensity spectrum, thereby to reveal thickness information of individual layers, and

a layer property determiner for determining, from said orthogonal transformation of said frequency spectrum, layer properties of layers on said part product,, and

a comparator, for comparing layers defined in said obtained intensity spectrum with layers defined in each of said predetermined intensity spectra, to determine a closest match between said obtained spectrum and one of said predetermined spectra, said determiner inferring said production history as including the respective completed stage corresponding to said closest match predetermined spectrum. --

Claim 29 has been amended as follows:

--29 (Amended).The use of aorthogonal transform processing on a spectrum obtained by reflecting multiple wavelength light from a plurality of points on a layered product, to determine layer thicknesses within said product, thereby to determine a production history of said layered product. --

Claim 30 has been amended as follows:

--30 (Amended). In a production line having a plurality of successive stages for construction of a product comprising at least one at least semi-transparent layer on a substrate, and routers for transferring partly constructed product between the stages such that each stage receives a respective predefined partly constructed product as its input, and having a predetermined intensity spectrum associated with at least one stage representing the respective part construction for the stage, a method comprising:

obtaining intensity spectra of partly constructed products incoming to said stage, said obtaining comprising

irradiating a part product at at least one point thereof with a multiple wavelength radiation source,

detecting intensities within reflections of said source from said point,

analyzing said intensities in terms of wavelength, thereby to produce a spectrum of intensities at respective wavelengths,

converting said spectrum of intensities into a frequency spectrum using orthogonal analysis transeformation of analyzed intensities, and

determining, from said orthogonal analysis of said frequency spectrum, layer properties of layers on said part product, and

comparing said obtained intensity spectralayer properties with layer properties of said predetermined intensity spectrum, and thereby determining whether said incoming partly constructed product corresponds with said respective predefined part construction for the respective stage. --

Claim 31 has been amended as follows:

--31 (Amended). A method according to claim 30, further comprising indicating a routing error when said spectra layer properties do not match. --

Claim 34 has been amended as follows:

--34 (Amended). A method according to claim 33, comprising obtaining intensity spectra for incoming partly constructed products to each stage, each said stage having a predetermined intensity spectrum defining layer properties. --

Claim 35 has been amended as follows:

--35 (Amended). A method according to claim 34, comprising comparing said obtained ~~intensity spectrum~~layer properties with predetermined spectra layer properties of at least one other stage to reroute said product to said other stage if said respective layer properties spectra match. --

Delete Claim 37

Claim 38 has been amended as follows:

--38 (Amended). A method according to claim 3730, wherein said property is one of a group comprising a thickness and a refractive index. --

Claim 39 has been amended as follows:

--39 (Amended). A method according to claim 3730, wherein said part product includes at least one at least partly transparent layer and said reflections include reflections from an upper and a lower surface of said at least partly transparent layer. --

Claim 40 has been amended as follows:

--40 (Amended). A production line according to claim 3730, wherein said converting comprises producing said spectrum by Fourier transform of said analyzed intensitiesorthogonal analysis comprises Fourier analysis. --